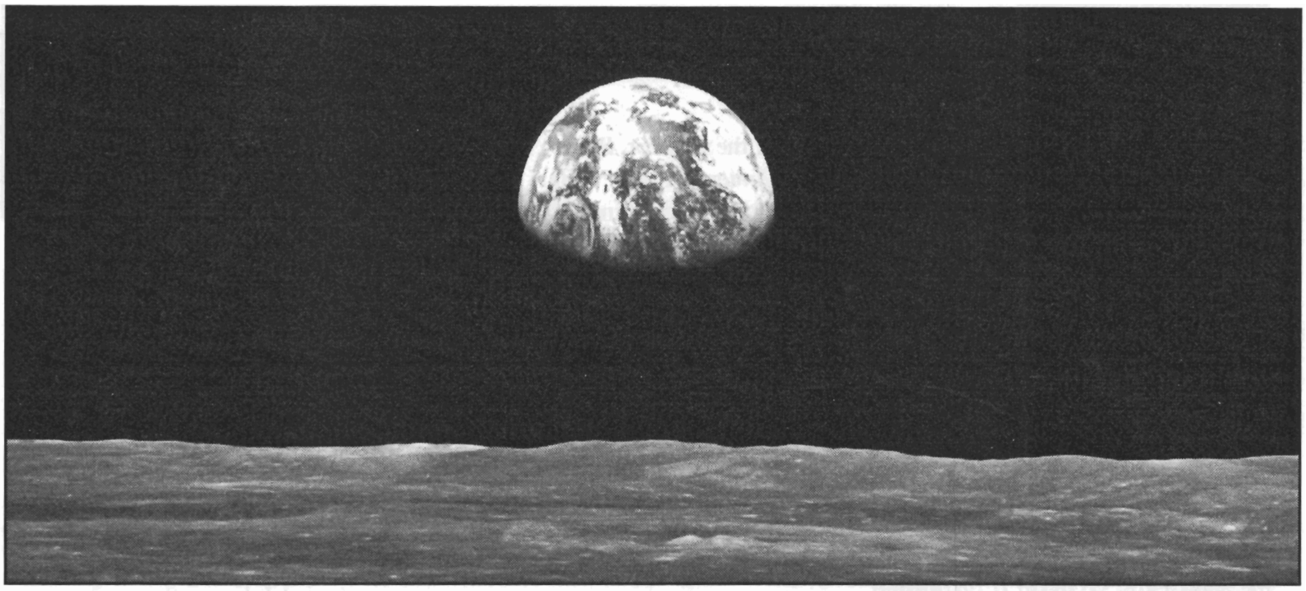
LUNAR *NEWS*

No. 56 January 1994



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Lunar News Mission

The purpose of "Lunar News" is to provide a newsletter forum for facts and opinions about lunar sample studies, lunar geoscience, and the significance of the Moon in solar system exploration.

Editor's Notes

"Lunar News" is published by the Office of the Curator, Solar System Exploration Division, Johnson Space Center of the National Aeronautics and Space Administration. It is sent free to all interested individuals. To be included on the mailing list, write to the address below. Please send to the same address any comments on "Lunar News" or suggestions for new articles.

Curatorial Phone Numbers

Lunar Samples, Thin Sections, All Sample Requests
Jim Gooding .... (713) 483-3274
Bill Phinney .... (713) 483-5310
Messages and General Information
Tari Mitchell .... (713) 483-5033
Antarctic Meteorites
Marilyn Lindstrom .... (713) 483-5135
Cosmic Dust and LDEF
Mike Zolensky .... (713) 483-5128
Educational Thin Sections
Jim Gooding .... (713) 483-5126
Loan Agreements and Records
Dale Browne .... (713) 483-5132
Technical Operations
Jim Townsend .... (713) 483-5331
Contamination Control
Dave Lindstrom .... (713) 483-5012

Mailing Address: SN2 Lunar Sample Curator, NASA
Johnson Space Center, Houston, Texas 77058-3696 USA

Electronic Mail:
Internet: gooding@sn.jsc.nasa.gov
NSI/DECNET: CURATE::GOODING

FAX: 713-483-2911

National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
Houston, Texas

Welcome, Tari Mitchell

In September 1993, the Office of the Curator achieved another improvement when Ms. Tari (pronounced Tare-ah) Mitchell joined us as our office secretary. Tari studied business administration at Lamar University and has worked at Johnson Space Center as an office trainee in other organizations. She is rapidly learning the curatorial business and has already brought new energy and ideas into the daily office operations. After two years without regular secretarial support, it is a delight to have Tari in charge of typing, copying, filing, mailing, and faxing as well as directing telephone traffic and helping us all maintain a high quality operation.

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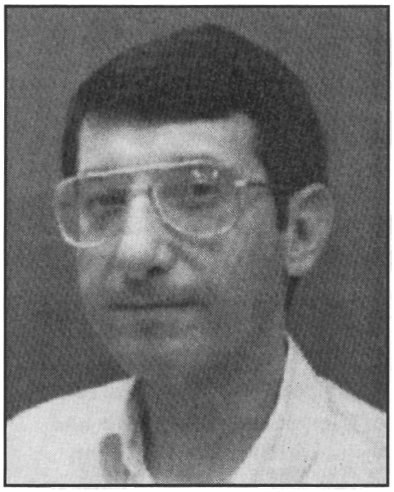
Facility made the soil sample available in record time. The Clementine engineering team at the Naval Research Laboratory, especially Chris Rollins, took time from an extremely tight schedule to set up the optical bench and operate the spacecraft. Izzy Lewis at Lawrence Livermore provided invaluable information on sensor operation. Carlé Pieters at Brown has acted as advisor and reality check throughout the test sequence.



Curator's Comments

By Jim Gooding
NASA/JSC

The Lunar Sample Caretakers

When a precisely packaged lunar sample arrives at its destination, along with its no-nonsense accountability paperwork, it is understandable that the customer might think that the entire process was orchestrated by benevolent robots. In truth, none of it would be possible without the tireless efforts of many dedicated human beings. Most of the time, those devoted people toil anonymously; a private assurance of a job well done is the usual surrogate for public recognition. But as a lunar science enthusiast—and possibly a lunar sample customer—you should really meet the people behind the work, if only on the pages of this newsletter.

Technical work in the Office of the Curator is performed by the Lockheed Engineering and Sciences Company (LESC) under the guidance of NASA staff scientists. Our goal is to work always as a single team with the interests of lunar sample science being foremost in mind. The responsibility for leadership and direction remains with the Curator and his NASA associates but the technical skills to accomplish our tasks reside largely with our LESC teammates.

The hands-on processing of lunar rock and soil samples is performed by Andrea Mosie, Linda Watts, and Kathleen McBride; Carol Schwarz processes regolith-core samples, among her other duties. All four possess Master of Science degrees in geoscience and the rare combination of dexterity and patience that is needed to accomplish difficult sample preparations in nitrogen glove cabinets. James Holder prepares the numerous polished thin sections and microprobe mounts of all varieties of lunar samples. His impressive skills allow researchers to apply highly sophisticated analytical instruments to rare mineral grains that can only be seen with a microscope. When a research sample is ready to ship, Susann Goudie prepares the necessary shipping documents and carefully wraps the package; she performs the same service for our educational sample disks and educational thin-section kits.

Altogether, this team ships about 1200 lunar research samples and about 40 educational kits each year. In addition, they annually process into our collection about 400 lunar research samples returned by investigators. Each team member takes pride in his or her role in fostering the continued study of the Moon.

In a future issue . . . meet the caretakers of the data system that tracks lunar samples and the operators of the mechanical systems that protect and preserve the samples.

From left to right: Kathleen McBride, Susann Goudie, Andrea Mosie, Linda Watts, James Holder (seated), and Carol Schwarz.

Apollo 17 Rock Catalog Delayed

We regret to report that Volumes 3 and 4 of the *Catalog of Apollo 17 Rocks* were not published and distributed in 1993 as originally forecast in previous issues of *Lunar News*. (Volumes 1 and 2 were published and distributed in February 1993 and copies are still available.)

Volume 3 (Central Valley, Part 2 by Clive R. Neal and Lawrence A. Taylor) was sent to printing in September 1993. Unfortunately, two events combined to set back the printing schedule. First, funding delays at the beginning of the new fiscal year (which began on October 1) prevented any high volume printing work from beginning before November 1993. Then, some high-priority printing work needed to support the Space Shuttle's repair mission to the Hubble Space Telescope came along and we stood aside for the greater good of astronomy and space science. We now expect that Volume 3 will be printed and available for distribution in March 1994.

Volume 4 (North Massif by Graham Ryder), our final installment, has lagged behind because of the hectic schedule of its author. A new plan and schedule for Volume 4 will be announced in the next *Lunar News*.

Clementine Spacecraft Sensors and Lunar Soil

By Carlton C. Allen[1] and Barry J. Geldzahler[2]
[1]Lockheed Engineering & Sciences Company
[2]Allied Signal Technical Services

Clementine, a cooperative mission of the Department of Defense and NASA, will be the first US spacecraft sent to the Moon in over 20 years. Clementine is primarily a test of advanced sensors in the deep space environment. Due to launch in early 1994, the spacecraft will conduct two months of lunar mapping, followed by a close flyby of the asteroid Geographos.

The mission is designed to map the entire lunar surface at medium resolution (100 - 200 m), as well as provide high-resolution (23 m) images of selected sites. The mapping data set will consist of near-simultaneous images acquired through fifteen narrow-band and three broad-band filters, selected for their utility in distinguishing surface units.

In November 1993, the response of Clementine's ultraviolet and visible (UV/VIS) wavelength sensor was tested using lunar soil 10084. These data provide sensor responses to a sample for which the composition and spectral signature are precisely known. Such use of target material to measure the response of an actual spacecraft imaging system is unique.

The instrument test was performed at the Naval Research Laboratory in Washington, DC during final checkout of the spacecraft. A 10 g sample of lunar soil was placed in an 8 cm diameter sample holder and illuminated using a halogen floodlamp. Light reflected from the sample was directed to the spacecraft sensor using two mirrors. Reference

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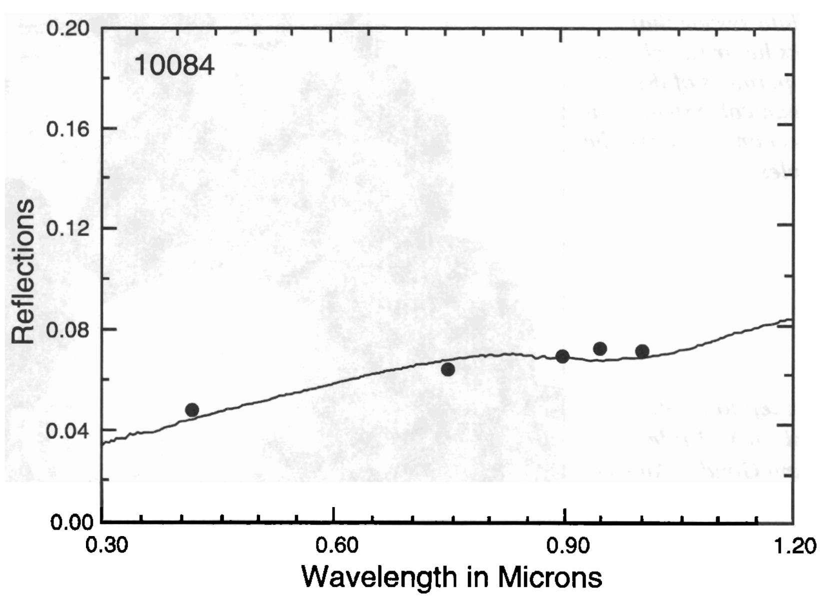

Lunar Samples Captivate Young Minds

By Linda Martel and G. Jeffrey Taylor
Hawaii Space Grant College
University of Hawaii at Manoa

Since it's inception in 1978, the Lunar Sample Loan Program has helped to stimulate interest in science and space exploration for thousands of students and educators nationwide. In the summer of 1993, we began work on a new document to supplement and enrich the use of the Lunar Sample Disk in the classroom. This new teacher's guide with activities, titled *Apollo—The Next Generation,* was co-written with ten local educators representing grades K-12. Each of these educators is known for his/ her excellence in science instruction. The seventeen activities in the new document promote problem-solving and communication skills as well as teamwork using hands-on and debate formats. Each activity consists of specific background information for the teacher as well as reproducible student sheets.

During the formal testing phase from Mid-October to mid-December 1993, thirty teachers at twenty-one schools across the state, used all or parts of the new document along with the Lunar Sample Disk. Testing sites included: ten elementary schools, five intermediate schools, and six high schools. Educators reported that the background material was easy to use even for the non-science specialist. They found that the activities were adaptable to all the grade levels and were easily integrated into other units such as math, social studies, geography, history, language arts, and art. This lunar disk project parallels a similar one headed by Marilyn Lindstrom for the Antarctic Meteorite Disk.

The activities in *Apollo—The Next Generation* divide into three units: Pre-Apollo, the Apollo Era, and the Future. These correspond, at least roughly, to studies that can be done before the Lunar Sample Disk arrives at a school (Pre-Apollo), while it is in the classroom (Apollo Era), and after the disk has returned to NASA (Future). The Pre-Apollo acitvities challenge the students' current knowledge of the Moon, its distance from Earth, its diameter, and its geology. They are asked to choose suitable landing sites based on this knowledge. Students are also given the opportunity to collect neighborhood rocks as a basis of comparison with the lunar samples. Careful observations of their own rocks and minerals and interpretations of the rock origins set the stage for the Lunar disk itself.

The Apollo Era activities focus on the rock and soil samples contained in the disk, as well as the processes that formed them. The lunar surface is examined more closely as are the actual Apollo landing sites and the astronauts' lunar roving vehicle. And for more in-depth study, four anomalies are presented to the students for their investigation and interpretation: Why does the Moon have fewer quakes than does the Earth? Why are there no obvious volcanoes on the Moon? Why are almost all the

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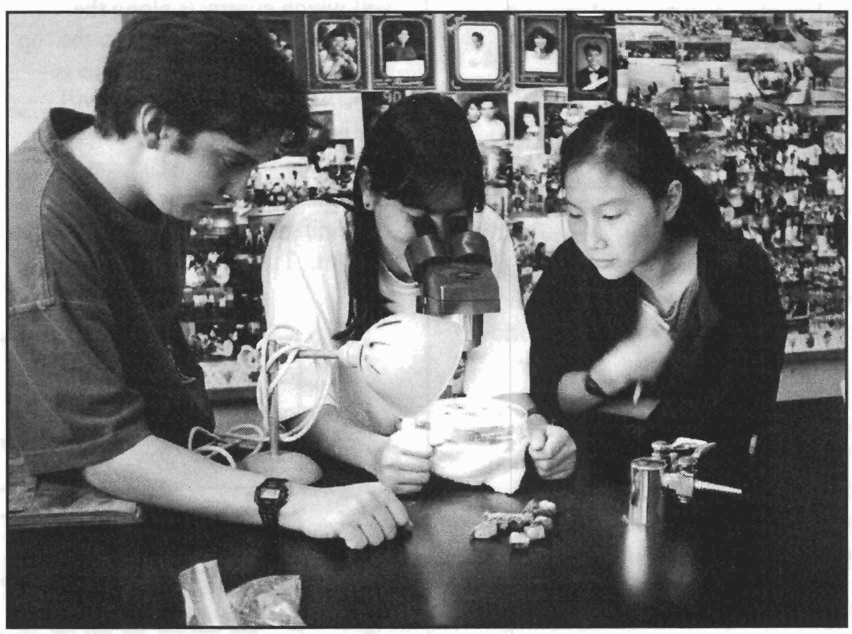


Ninth grade science students from Waipahu High School, Hawaii view the Lunar Sample Disk as part of an activity from the new ***Apollo—The Next Generation*** *document.*

Lunar Samples Captivate Young Minds continued from page 5

maria on the nearside of the Moon? Why does the Moon currently have such a weak magnetic field?

The Future activities are designed to spark students' interest in considering the feasibility of sustaining life on the Moon. Discussions of land use and balanced life support systems lead to actual construction of models. Students must contend with such details as development plans for mining, transportation, air and water supplies, and waste management.

During the testing phase, educators supplemented this curriculum with videos, guest speakers, and family-oriented, telescope-viewing parties. The children were so captivated by the Lunar Sample Disk and related projects that their parents even made special visits to the schools. Guests were so excited and impressed with the work at one small school that a company donated $1000 to their school fund.

Apollo—The Next Generation helps educators to supplement their science and math curriculum with the excitement and adventure of space exploration. The Lunar Sample Disk is an invaluable tool. We've seen how the study of the Moon comes alive for a new generation of students, many of whom have parents not even old enough to have personal recollections of Neil Armstrong's historic step. The history lesson of our manned space program is intricately tied to the Lunar Sample Disk. Not only can we share this history, but involve the students of today in the dreams of space exploration for tomorrow.

New Samples Available From Lunar Core 68002/1

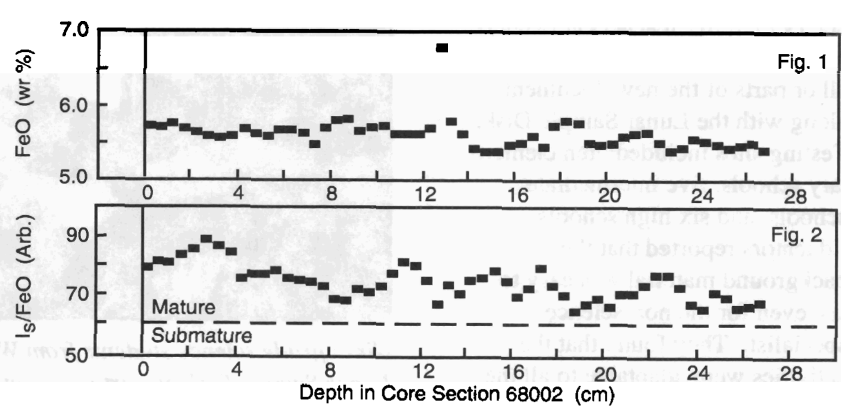
By Carol Schwarz[1], Richard V. Morris[2], and Randy L. Korotev[3]
[1]Lockheed Engineering and Sciences Co
[2]NASA/JSC
[3]Washington University

68001, the bottom section of the Apollo 16 double drive tube 68002/68001, was extruded on December 14, 1993, and samples will soon be available for study. The length of 68001 after extrusion was 34.1 cm; thus the total length of 68002/1 was 61 cm.

The color of 68001 varied from 10YR 5/1 to 7/1 on the Munsell Color Scale and several color boundaries were observed after derinding. A void at the top end extended to about 1.5 cm. At 0 to 10 cm from the top end was a dark layer, approximately 10YR 5/1. The particles greater than 1 mm consist mainly of friable soil breccias and clods, and black fine-grained glassy fragments. From 10 to about 13 cm is lighter colored soil which contrasts along the upper boundary adjacent to the top layer. The color of this layer is approximately 10YR 7/1 to 6/1 with millimeter-sized light gray fragments visible. At 13 cm the color darkens to about 10YR 5/1, lightening gradually towards the bottom. The core will be dissected in three 1-cm-thick longitudinal layers (passes) starting at the top and continuing through the length of the 34.1 cm core.

FeO and I_s/FeO depth profiles for section 68002, which was dissected earlier in 1993, are shown in Figures 1 and 2. To smooth out sampling artifacts, the data are three-point sliding averages, except for the anomalous point in the FeO data. The anomalous point probably represents a chance occurrence of a large metallic iron particle in that particular sample. The FeO content is nearly constant and averages 5.63 (20) wt. %. All of the soil in the upper core section is mature. There are no significant discontinuities, although the maturity generally decreases from the lunar surface.

All requests for material from 68001 and 68002 should be made following the normal procedure used for lunar sample requests (see page 10). It is anticipated that CAPTEM will review requests for 68002/1 samples at its March 1994 meeting.



Catalog of Apollo Experiment Operations - NASA RP 1317

By Thomas A. Sullivan
NASA/JSC

The accomplishments of the Apollo missions to the Moon unfolded on the TV screens of the world almost as a given. While there were certainly moments when things did not go as planned, for the most part it looked easy. Walking and driving on the lunar surface, laying out experiment packages, and collecting samples all seemed as natural as the many science fiction stories we had been reading for years.

Of course, it wasn't that easy. Years of planning, training, rethinking, and improvement had gone into those operations. Carrying out useful work from inside a pressure suit required a great deal of compromise on the part of experiment designers and mission planners. Even then, many tasks which were accomplished turned out to be extremely difficult. The lunar environment—especially its dust, low gravity, and vacuum—made it difficult to perform many operations. The need for a pressure suit lowered the productivity of an individual, making it a constant struggle to merely grip something.

The progress made in the late 1960s and early 1970s was not as well documented as one might have hoped. We were running so hard that no one had the time to write down the operational lessons learned in an organized fashion. This new catalogue reviews the Apollo mission reports, preliminary science reports, technical crew debriefings, lunar surface operations plans, and various other relevant lunar experiment documents, collecting *engineering* and *operation-specific* information. This is what it takes to do science in space. It does *not* focus on the science or scientific results, but does list the purpose of the experiment and a brief description of it. It is organized by experiment and equipment items emplaced or operated on the lunar surface during the Apollo missions. It attempts to summarize the general *operational* problems encountered on the surface and provides guidelines for the design of future lunar surface experiments with an eye towards their operation.

Someday we will be going back to the Moon and onward to Mars. Many of the things we want to do there will be similar to those we have already done. True, the instruments will be better and may be used for different purposes, but the tasks required of an astronaut and the design problems faced by the engineers will largely be the same. This reference document hopes to capture some of the lessons learned from the Apollo era to make the jobs of future planetary scientists, principal investigators, astronauts, engineers, and operators of lunar experiments more productive.

Many of the problems encountered on the lunar surface originated from just a few conditions that manifested themselves in various nasty ways. Low gravity caused cables to stick up and get caught on feet, and also made it easy for instruments to tip over. The dust was abrasive and caused

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Clementine Calibrations
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images were taken from a pressed halon standard (95% reflectance), and dark field images were obtained by covering the sensor. The lunar sample image covered approximately one fourth of the 288 x 384 pixel CCD array.

Brightness values from the central half of each image were averaged. Dark field signals, corrected for the characteristics of the sensor, were subtracted from the sample and reference material averages. The resultant sample brightness was then divided by the reference material brightness to obtain absolute sample reflectance.

The figure on page 4 shows reflectance values obtained by the UV/VIS sensor using its five narrow-band filters (0.415, 0.750, 0.900, 0.950, and 1.000 µm). These values are superimposed on a reflectance spectrum of soil 10084 taken with the RELAB instrument at Brown University. Clementine data match the RELAB spectrum to within a few per cent at all five wavelengths.

These data indicate that the Clementine UV/VIS filters appear to have no significant light leaks or other discrepancies which systematically yield different reflectance values than are obtained from laboratory measurements. Also, this pre-flight testing provides a solid baseline of measurements against which to judge sensor degradation during the mission. Finally, it is hoped that these data, combined with Clementine multispectral images, will document soil heterogeneity at the Apollo 11 site.

This work could not have been accomplished without the outstanding support of many people. Dave McKay at JSC came up with the original idea. Jim Gooding and his staff at the Lunar Curatorial

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Catalog of Apollo Experiment Operations continued from page 7

visibility and thermal control difficulties. Operating in a pressure suit limited a person's activity, especially in the hands.

The original motivation for this database came from Dr. Bonnie Dunbar of the Astronaut Office who, at the time, headed the Science Support Group. She wanted to document the experience of the astronaut/experiment interface from the operations perspective. Beyond that, it retains some of the "lessons learned" from the Apollo program so that, in the future, we won't repeat the earlier mistakes, special attention must be paid to design of instruments and tools for operation by a crewmember in an EMU, with time constraints, on a planet with low gravity.

In addition to the usual meaning of the term "experiment," some pieces of equipment and hardware, such as the lunar rover and some of the tools the crew had available, are included. Also included in this database are seven microgravity experiments performed in the command module during trans-lunar and trans-Earth coasts that were precursors to some Skylab experiments. While we have come a long way since then, some of the problems we still have in microgravity today were first seen in the Apollo command module.

Within each experiment, general information is provided about the principal investigator and other contacts, experiment mass and dimensions, manufacturer, and the mission(s)on which it flew. Brief descriptions of the hardware and its purpose are provided. After this, a general set of questions that are operational in nature is applied to the experiment so that the interaction of the crew with the experiment or hardware can be understood. Not all questions make sense for each experiment, but a standard battery of questions was applied to all with the idea that it might trigger the recollection of some unique aspect of that operation. Many experiments flew on more than one mission, and improvements were made for the follow-on flights based on the difficulties experienced on early flights. A cross reference to similar experiments from Apollo or other efforts is provided. The document has also been converted into an electronic database that can be searched using many different query types. This is now complete in the "FileMaker Pro" format which should be usable by either PCs or Macs, although it has only been tested on a Mac.

A major question for planning operations on the lunar surface includes which experiments or tasks will be performed. Comments regarding overplanning of the Apollo timelines and having little time to explore and think while performing an EVA are certainly ones that have been voiced by the crews and some of the PIs of the era, but it is a complex question that must be traded off against what one would have been willing to forego in order to do more "thinking and exploring." How do we measure the improvement in sample selection vs. a greater number of samples, an increased number of measurements, or an improved deployment of an instrument? How many samples are we willing to give up? How much poorer are documentation of the samples? How many fewer magnetometer or gravimeter measurements? Each discipline would have a different set of answers.

The Apollo traverse planners tried to take these considerations into account by providing some time at most of the stations for general observations and descriptions, and by trying to arrive at an overall science consensus before the mission, via the Science Working Panel, as to what was a reasonable balance of time allocations among the various experiments. Certainly, in the early missions the EVA timelines were scheduled very tightly. In the later missions, however, more EVA time, better training, and an emphasis on exploration resulted in a more relaxed approach to the field geology experiment. It is questionable whether Apollo would be done any differently today if we were going back to the Moon with the same constraints on time available at a given site. When we have a permanent outpost and an opportunity to have longer visits to an area, this approach may change. It must be realized, however, that this won't happen even in the first few years of an outpost. The number of potentially interesting things to do near just about any site can quickly consume all possible EVA time. Also, Apollo had months to plan and train for each mission. Similar Earth support for an equivalent effort when EVAs happen daily is probably not realistic, so more "local" planning may be essential. Add to this the realization during Skylab 4, and practiced during Shuttle missions today, that some crew autonomy is necessary, and it is likely that an approach to the desired "thinking and exploring time" may result, even if some loss of efficiency also arises.

The "Catalog of Apollo Experiment Operations" is a good reference on the reality of science operations on the Moon in the past. Hopefully, it will be useful to the PIs of the future. Interested readers can obtain a copy by contacting Tom Sullivan at NASA - JSC, Mail Code SN4, 2101 NASA Road One, Houston, TX 77058.

APOLLO EXPERIMENTS AND MISSIONS

Number	Surface Experiment	Apollo Mission 11	12	14	15	16	17
S 031	Passive Seismic	X	X	X	X	X	
S 033	Active Seismic			X		X	
S 034	Lunar Surface Magnetometer		X		X	X	
S 035	Solar-Wind Spectrometer		X		X		
S 036	Suprathermal Ion Detector		X	X	X		
S 037	Heat Flow				X	(l)	X
S 038	Charged Particle			X			
S 058	Cold Cathode Gage		X	X	X		
S 059	Lunar Geology	X	X	X	X	X	X
S 078	Laser Ranging Retroreflector	X		X	X		
S 152	Cosmic Ray Detector					X	X
S 198	Portable Magnetometer			X		X	
S 199	Traverse Gravimeter						X
S 200	Soil Mechanics	X	X	X	X	X	X
S 201	Far UV Camera/Spectrograph					X	
S 202	Lunar Ejecta and Meteorites						X
S 203	Lunar Seismic Profiling						X
S 204	Surface Electrical Properties						X
S 205	Lunar Atmospheric Composition						X
S 207	Lunar Surface Gravimeter						X
S 229	Neutron Probe						X
M 515	Dust Detector	X	X	X	X		
Time on Moon (hours)		22	32	33	67	71	75
Number of EVAs		1	2	2	3	3	3
Duration of EVAs (hours)		2.8	7.8	9.4	18.6	20.2	22.1
Total Traverse Length (km)		0.25	2.0	3.3	27.9	27.0	35.0

(l) Cable broken during deployment.

Other lunar surface equipment items considered: Lunar Rover Vehicle, Erectable S-Band Antenna, Modularized Equipment Transporter, TV stand, Flag, Universal Handling Tool, Dome Removal Tool, Fuel Transfer Tool, Radioisotope Thermal Generator, Lunar Equipment Conveyor, Cameras, Surveyor 3 Retrieval, Thermal Degradation Sample Experiment, ALSEP - General Information, and EASEP - General Information.

Microgravity Experiment	Apollo Mission 11	12	14	15	16	17
Composite Casting Demonstration			X			
Electrophoresis Demonstration			X		X	
Heat Flow and Convection Demonstration			X			X
Light Flashes Experiment	X	X	X	X	X	X
Liquid Transfer Demonstration			X			

How to Request Lunar Samples

NASA policies define lunar samples as a limited national resource and future heritage and require that samples be released only for approved applications in research, education, and public display. To meet that responsibility, NASA carefully screens all sample requests with most of the review processes being focused at the Johnson Space Center (JSC). Any and all individuals requesting a lunar sample should follow the steps given below for the appropriate category of sample.

1. RESEARCH SAMPLES (including thin sections)

NASA provides lunar rock, soil, and regolith-core samples for both destructive and non-destructive analysis in pursuit of new scientific knowledge. Requests are considered for both basic studies in planetary science and applied studies in lunar materials beneficiation and resource utilization.

A. The sample investigator demonstrates favorable scientific peer review of the proposed work involving lunar samples. The required peer review can be demonstrated in any one of three ways: (1) A formal research proposal recommended by the Lunar and Planetary Geosciences Review Panel (LPGRP) within the past three years; (2) A formal research proposal recommended by the Indigenous Space Resources Utilization (ISRU) panel for work pertaining to the specific sample request (step B); (3) Submittal of reprints of scientific articles pertaining directly to the specific research methods to be applied to the samples (step B), and published in peer-reviewed professional journals.

B. The investigator submits a written request specifying the numbers, types, and quantities of lunar samples needed as well as the planned use of the samples. For planetary science studies, the sample request should be submitted directly to the Lunar Sample Curator at the following address:

Dr. James L. Gooding
Lunar Sample Curator
SN2
NASA/Johnson Space Center
Houston, TX 77058-3696
USA
Fax: (713) 483-2911

For engineering and resource-utilization studies, the sample request should be submitted to the Lunar Simulant Curator at the following address:

Dr. Douglas W. Ming
Lunar Simulant Curator
SN4
NASA/Johnson Space Center
Houston, TX 77058-3696
USA
Fax: (713) 483-5347

The Lunar Simulant Curator will arrange for an ISRU review of the applications-oriented sample request to assure that all necessary demonstration tests with simulated lunar materials have been satisfactorily completed. Requests determined to be sufficiently mature to warrant consideration for use of lunar materials will then be forwarded to the Lunar Sample Curator.

For new investigators, tangible evidence of favorable peer review (step A) should be attached to the sample request. Each new investigator should also submit a résumé.

Investigators proposing the application of new analytical methodologies (not previously applied to lunar samples) also should submit test data obtained for simulated lunar materials. New investigators who are not familiar with lunar materials should consult *Lunar Sourcebook: A User's Guide to the Moon* (G. Heiken, D. Vaniman, and B. M. French, Eds.; Cambridge University Press, 736 pp.; 1991; ISBN 0-521-33444-6) as the best available reference on the chemical and physical properties of lunar materials.

C. The Lunar Sample Curator will research the availability of the requested samples and decide whether a unilateral action can be taken or an outside scientific review is required. Outside review is prescribed for all new investigators and for most established investigators except where returned (previously used) samples are being requested. For outside review, the Curator forwards the original request, with background information, to the Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM), a standing committee of scientists who advise NASA on the care and use of lunar samples. CAPTEM checks for favorable peer review (step A) and appropriate sample selection (step B).

D. Given CAPTEM endorsement and concurrence by NASA Headquarters, the Lunar Sample Curator will prepare a Lunar Sample Loan Agreement for signature by the investigator's institution. The agreement includes a simple security plan that prescribes precautions to minimize prospects for theft or unauthorized use of lunar samples.

E. Upon receipt of the properly executed loan agreement, the Lunar Sample Curator prepares the authorized samples and sends them to the investigator. Quantities less than 10 grams can be sent directly by U. S. registered mail to domestic investigators. Shipments to foreign investigators are sent by U. S. diplomatic pouch mail to the American embassy nearest the requestor's location. Quantities larger than 10 grams must be hand-carried by the investigator or his/ her representative.

F. Continuation as a Lunar Sample Investigator. An investigator's privilege for retention and use of lunar samples is contingent upon continued good standing with the Office of the Curator. The investigator will remain in good standing by fulfilling the following obligations: (1) Maintenance of, and adherence to, the lunar sample loan agreement and security plan; (2) Timely cooperation with annual lunar sample inventory; (3) Timely cooperation with sample recalls.

2. PUBLIC DISPLAY SAMPLES

NASA provides for a limited number of rock samples to be used for either short-term and long-term displays at museums, planetariums, expositions, or professional events that are open to the public. Requests for such display samples are administratively handled by the JSC Public Affairs Office (PAO). Requestors located in the United States should apply in writing to the following address:

Mr. Boyd E. Mounce
Lunar Sample Specialist
AP4/Public Services Branch
NASA/Johnson Space Center
Houston, TX 77058-3696
Fax: (713) 483-4876

Requestors in foreign countries must contact the public affairs officer of the United States Information Service (USIS) at the nearest American embassy. The USIS will contact Mr. Mounce to determine whether the loan of a display sample is appropriate.

For both domestic and foreign requestors, Mr. Mounce will advise successful applicants regarding provisions for receipt, display, and return of the samples. All loans will be preceded by a signed loan agreement executed between NASA and the requestor's organization. Mr. Mounce will coordinate the preparation of new display samples with the Lunar Sample Curator.

3. EDUCATIONAL SAMPLES
(disks and educational thin sections)

A. Disks

Small samples of representative lunar rocks and soils, embedded in rugged acrylic disks suitable for classroom use, are made available for short-term loan to qualified school teachers. Each teacher must become a certified user of the disks through a brief training program prior to receiving a disk. Educational sample disks are distributed on a regional basis from NASA field centers located across the United States. For further details, prospective requestors should contact the public affairs office at the nearest NASA facility or write to the following address:

Mr. Larry B. Bilbrough
FEE/Elementary and
Secondary Education
NASA Headquarters
Washington, DC 20546
Fax: (202) 358-3048

B. Thin Sections

NASA prepared thin sections of representative lunar rocks on rectangular 1 x 2-inch glass slides, with special safety frames, that are suitable for use in college and university courses in petrology and microscopic petrography for advanced geology students. Each set of 12 slides is accompanied by a sample disk (described above) and teaching materials. The typical loan period is two weeks, including round-trip shipping time. Each requestor must apply in writing, on college or university letterhead, to the following address:

Lunar Sample Curator
SN2
NASA/Johnson Space Center
Houston, TX 77058-3696
Fax: (713) 483-2911

For each approved user, the Curator will prepare a loan agreement to be executed between NASA and the requestor's institution prior to shipment of the thin-section package.

Accessing the JSC SN2 Curatorial Data Bases

The Office of the Curator maintains publicly available, dial-up electronic data bases of inventory information for lunar samples as well as for other sample collections in our care. The data bases are built upon the processing and allocation histories of samples, rather than on compositional data, but can be used advantageously by investigators who are researching the availability of parentage of specific samples. The curatorial data bases can be accessed as follows:

Via DECNET	1) Log onto your host computer. 2) Type **SET HOST 9300** at the system prompt. 3) Type **PMPUBLIC** at the USERNAME: prompt. NOTE: Your system manager may add node CURATE to the DECNET data base on your host computer; the SPAN node number is 9.84. You may then access CURATE by typing **SET HOST CURATE** instead of **SET HOST 9300**.
Via INTERNET	1) Type **TELNET 146.154.11.35** or **TELNET CURATE.JSC.NASA.GOV.** 2) Type **PMPUBLIC** at the USERNAME: prompt.
Via modem	The modem may be 300, 1200, or 2400 baud; no parity; 8 data bits; and 1 stop bit. If you are calling long distance, the area code is 713. 1) Dial 483-2500. 2) Type **SN_VAX** in response to the Enter Number: prompt. 3) Hit <CR> 2 or 3 times after the CALL COMPLETE message. 4) Type **J31X** in response to the # prompt. 5) Type **PUBLIC** in response to the Enter Username> prompt. 6) Type **C CURATE** in response to the XYPLEX> prompt. 7) Type **PMPUBLIC** at the USERNAME: prompt.

For problems or additional information, you may contact:

Claire Dardano
Lockheed Engineering & Sciences Company
(713) 483-5329

Carol Schwarz
LESC, M/S C23
Houston, TX 77058